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-COMMUNIST CHINA-

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CHINA'S ADVANCES IN CHEMISTRY IN THE PAST DECADE

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At the time of the Chinese People's Liberation in 1949, chemical research in China, like many other sciences, was very meager. This was due chiefly to prolonged suppression and discouragement on the part of the imperialists and domestic reactionary governing class.

From the beginning of this century until the Liberation, Chinese chemists had always faced extremely difficult conditions. For a period of thirty years, only a few prominent works can be mentioned, such as the Solvay process of soda by Hou Te-pang, the steroids study by Chuang Ch'ang-kung, the medicine herb research including Corydalis ambigua (Yen-hu-su) and Ephedrine (Ma-huang-su) by Chao Ch'eng-ku, etc.

The Chinese people took over three old Chinese chemical research centers during 1949 and 1950. Of these, the largest was the Chemical Institute of the Central Academy in Shanghai. It had a staff of thirty-three members, including nineteen senior and junior research fellows.

After the Chinese People's Liberation, Academia Sinica was established in 1949. This led Chinese scientists to work for immediate national economic rehabilitation. Since the beginning of the First Five-Year Plan, Chinese scientists have also helped realized a national planned economy and have developed Chinese science.

For the past decade, the government has given scientific work great support. Therefore, chemical progress, like other sciences, has achieved new heights in Chinese science history.

Today, Academia Sinica has the following chemical centers: the Peiping Chemical Institute, the Ch'ang-ch'un Applied Chemistry Institute, the Dairen Petroleum Institute, the Shanghai Organic Chemistry Institute, the Pharmacological Institute, the Silicate Institute, and the Biochemistry Institute.

Moreover, many chemical research works are carried out in other centers, such as the Geology Institute, the Metals Institute, the Metallurgical Institute, the Metallurgical Industry Institute, the Mining Institute, and the Coal Institute.

Some of these institutes were organized during the past decade, and some were extensions over old foundations. The larger chemical institutes have more than two hundred research fellows. At the same time, many production departments of the government have also set up large research centers, such as the Ministry of Chemical Industry, the Ministry of Geology, the Ministry of Metallurgy, the Ministry of Agriculture, the Ministry of Health, the Ministry of Petroleum Industry, and the Ministry of Coal Industry.

These carry out a considerable amount of chemical work. In 1958, many chemical institutes were established in the branches of Academia Sinica in different provinces. These include the Elements and Organic Chemistry Institute in Hopeh Province, and the Applied Chemistry Institute in Canton.

Under the auspices and guidance of the Chinese Communist Party, Chinese scientific work has been redirected to avoid old unrealistic pathways.

Right after the Liberation, the Central People's Government organized the scientists, and had them participate in the conferences of different departments of production. This offered them an opportunity to learn the national need of their own special training.

Hence, they spontaneously offered their efforts to serve the country and the people. For example, there were many conferences of trades related to chemistry during 1949-1950, including those on coals, non-ferrous metals, the chemical industry, petroleum, the oil industry, health, science, the rubber industry, the pharmaceutical industry, the paper industry, reagents preparation, and the tanning industry.

These conferences helped many laboratory-confined scientists understand the productive activities of

China as well as the involved problems that ought to be studied.

Chinese chemists are beginning to consider how to combine research and national needs. They are earnest in research and they cultivate a large number of young chemists. In ten years, they have opened numerous chemical areas which were once barren or unexploited in China, such as the studies on the rare metals, rare earth elements, petroleum, antibiotics, cellulose, coals, silicates, high molecule chemistry, high molecule physical chemistry, semi-conductor chemistry, salt lake resources, instrumental analysis, organic polymers and natural drugs, agricultural chemicals, dyes, and perfume. The development of these studies illustrates the immensity of the chemical wasteland left by the old China.

The development of these chemical research areas has exerted an important influence upon the economic life of China. Before Liberation, China was accused of being a country without petroleum, copper, or an adequate supply of iron ore and metals. The important metals, such as tungsten and molybdenum which were abundant in China, were exported only as ores.

Beryllium, niobium, tantalum, and ferro-titanium minerals were only used as exhibits in the museum. The anode sludge and the chimmey soot of the smelters were disposed of as wastes, not to speak of a comprehensive utilization of minerals.

The famous Chinese porcelain industry declined, and silicate products, including ordinary glass, chemical glass, porcelain, and insulating porcelain, were imported in large amounts. Petroleum, lubricants, steel and metal products,paper, fertilizers, agricultural chemicals, drugs, dyes, perfume, pens, and ink were also imported profusely. Some refined chemicals, such as drugs and dyes, were sold at such exorbitant prices by the imperialists that many Chinese patients could not be properly treated.

Now, the Chinese people have discovered many petroleum resources of their own, and have mastered the processing techniques needed to produce different grades of petroleum and lubricants. The once omnipresent tin cans of Standard Oil and "Shell" are no longer seen. Through the coordination of geological survey, chemical analysis, and metallurgical study, China can make

different kinds of alloys from her own resources. Some industries are utilizing machines which are completely made in China.

The Chinese silicate industry now can meet the huge demand for construction materials, electrical equipment, and daily consumption. The Chinese have their own inexpensive domestic-made medicine. The farmers have larger supplies of fertilizer and agricultural chemicals. Many Chinese are using fine-grade, domestic-made paper, pens, and ink to develop their cultural life. China-made dyes and perfume are also available to the people, and they make the Chinese festivals and congregations all the more colorful and glorious.

Since the old China left us such a broad open field in chemistry, Chinese chemists had, naturally, in the past decade to muster the national resources, and put an extra effort on obtaining chemical knowledge from many industrially-advanced countries.

Only through constant efforts shall we be able to prevent valuable minerals from being used merely as exhibits. They will, instead, be used abundantly as metal and non-metal raw materials in industry to produce petroleum, lubricants, macromolecular compounds, semi-conductors, etc. We can thus produce from wood, herbs, coal, and bacteria hundreds of varieties of paper for daily consumption and industrial uses, thousands of chemical reagents, the common antibiotics and drugs, ordinary dyes, perfumes, plastics, and rubber.

China's natural resources are consolidated, and new methods of chemical analysis, separation, sysnthesis, and processing have been invented. These works also stimulate the study of chemical kinetics, thermochemistry, colloid chemistry, electrochemistry, and the structure of matter.

Chinese chemists during the past decade have been gradually converted from pioneers in a wide and wild chemistry field to constructive scientists. They are very earnest in following the leadership of the Party to march toward a bright future.

The Central Committee of the Chinese Communist Party promulgated a program for the development of national agriculture in 1956. In the same year, through the combined efforts of many qualified Chinese scientists, the Party set a Twelve-Year Plan for the development of science and technics. These plans have encouraged the growth of many new subjects of science.

A brief report of advances in chemistry in the past decade is presented as follows:

We have done a great deal of new study on rare metals, such as the preparation of spectrally pure compounds and super-pure metals, the extraction of rare elements, the separation of complex minerals, and the synthesis of special compounds. Now the Chinese inorganic chemists have begun to master methods of separating and extracting rare elements from essential national resources. They have opened a new way for further research into and application of these elements.

Analysis and separation of the rare earth elements were started on the study of monozite by the Ch'ang-ch'un Applied Chemistry Institute of Academia Sinica. Chemists there first solved the problem of a thorium supply for industry, and then carried out research on rare earth elements.

Other chemical research projects concerning the combined resources of important national metals deal with the preparation and properties of homopoly and heteropoly tungstic acids, the study of thiocyanide complexes of molybodum and thalliu, the liquid phase extraction of molybdenum and rare earth elements, the phase equilibrium of melting salt systems and water-salt systems, and the thermal decomposition of a few salts.

In response to the need for an analysis of these minerals, the analytical chemists have greatly enriched avaialable chemical methods, including chemical analyses and instrumental analyses. They have also made contributions in the analytical methods of molybdenum, tungsten, thorium, rare earth elements, niobium, tantalum, and platinum.

The salt-lake research has provided a rich source of potassium for fertilizers, and has also increased the supply of certain light elements.

The petroleum chemists, applying the principles of gas chromatography, are studying the absorption of gases by silicon of various diameters. They have also studied chemical absorption by different catalysts, and the selection of absorbents. Research on lubricants has helped the chemists understand the stability of colloidal systems.

Immediately after Liberation, major organic chemistry work was concerned with the industrial pro-

duction of the major antibiotics. In the First Five-Year Plan, basic problems in the production of penicillin, chloromycetin, aureomycin, and streptomycin were solved. The organic chemists have also studied the structures of aureomycin, streptomycin, critrinin, clavin, and the carinolytic actinomycetin K.

The organic chemists have studied the glycosides and genin of numerous Chinese medicinal herbs. They studied Sentellaria baicalensis, Georg., Huai-hua-mi, Ta-tan-tzu, and Momordica cochinensis, Spreng. for their specific glycosides, and Fritillaria verticillata, Willd., Veratrum nigrum, L., Menispermum dauricum, D. C. Lo-fu-mu, and Orixa japonica for their alkaloids. There are also some studies of the plant terpanes, among which the most important one is an ascaricid from Artemisia.

In 1958, the Organic Chemistry Institute of Academia Sinica made great progress in choosing a synthetic method of producing steroids in large amounts and at a relatively low cost. They used domestic-made sitosterol, cholesterol, and diosgenin from yam-family plants as the raw materials, and synthesized ten different steroids: dehydroepiandrosterone, cortisone, hydrocortisone, dehydrocortisone and dehydrocortisol, desoxycorticosterone, progesterone, ethisterone, testosterone, testosterone propionate, and methyltestosterone.

Many contributions were made on the stereochemistry of Santonin, the heterocyclic chemistry of pyrimidine and quinazoline, and the structure of alkaloid of Menispermum dauricum, D.C..

We also benefited from the study of aromatic vegetable oil, and are producing turpentine, Shan-tz'ang-tzu oil, orange peel oil (Oleum aurantii), lemongrass oil, laurel oil, thyme oil, sassafras oil, and aromatic camphor oil.

The pharmacologists have been studying Chinese herb medicines and have found some of therapeutic value in high blood pressure, cancer, and acute appendicitis. They have also synthesized many antibiotics, studied chloromycetin and its cogeners, and the relationship between their chemical structure and pharmacological properties.

For the eradication of schistosomiasis, Chinese pharmacologists have, in the past ten years, synthesized

hundreds of organic compounds of antimony hoping to find a schistosomicide more effective and less toxic than tartar emetic.

The Pharmacology Institute of Academia Sinica found that the aryl ether of dimercaprol and its antimony sulfonate is more effective then tartar emetic when taken by mouth, and that antimony benzyl thioglycollic acid is superior to tartar emetic when given to the animals intraperitoneally. The Health Department cured more than 580,000 cases of schistosomiasis during the past seven years with domestic-made antimony sodium gluconate.

Since the promulgation of the program of national agricultural development by the Central Committee of the Chinese Communist Party in 1956, many institutes have been preparing a series of insecticides and bactericides which have been proved useful internationally.

The Peiping College of Agriculture, the Chinese Academy of Medicine,and the Chemistry Department of Nan-k'ai University have synthesized a series of organic phosphorus compounds and studied their toxicity with the Insect Institute of Academia Sinica.

Much unprecedented work on organic compounds containing silicon, fluorine, mercury, tin, arsenic, aluminum, magnesium, iodine, bismuth, etc. has been done. A tin-containing organic compound has proved to be a better bactericide than a commercially available bactericide.

Our chemists started from scratch to produce important high-molecular compounds, including plastics, rubber, and cellulose. Some have been prepared successfully in the laboratories, and some are in intermediate stages of experimentation or production. These high-molecular compounds consist of polyethylene, polyethylenebenzene (styrene), polychloroethylene, polymethylester of acrylic acids, butadiene-benzene rubber, chloroprene rubber, arsenoprene rubber, polyadipicurethane (polyhexylurethane), and other polyurethanes, phenol-aldehyde resin, ion-exchange resins, polysulfur rubber, and polysilicoxoalkane.

Our high-molecular chemists not only work industriously to learn techniques from other countries, but also invent their own. For instance, they have made an ion-exchange resin which has a relatively high purification efficiency and maintains a constant volume during the exchange of ions.

They studied the kinetics reaction of polymerization of several compounds, and determined the rate of their competitive polymerization. Their studies on the reaction kinetics of condensation and polymerization help us to understand the mechanism of esterification. They also study the reaction mechanism of condensation and polymerization of hexyl urethane.

There are some interesting reports on the theoretical analysis and experimental determination of molecular weight distribution in the polymers. As regards the high molecular compounds that contain special elements, the chemistry of high molecular silicorganic compounds has been developed at a higher speed. Chemists have done some very important work on the chemical properties of the units and the reaction mechanism of their polymerization.

In the study of high molecular physical chemistry, following the development of high molecular synthesis, we have worked on the molecular weight distribution and its measurement, the determination of internal and external double chains of the high molecules, the measurement of the electrocouple of high molecular solution, the relationship between the structure of high molecules and their mechanical properties, as well as their crystalline tropism.

As regards the natural high molecules, we have made a survey of our rubber plants, especially Eucommia ulmoides, Oliv.. Its gum is abundantly produced in China, and we have done a lot of analysis and property study of this gum.

Our study of cellulose has solved the problem of our paper pulp supply. We have also proceeded to study the preparation of synthetic fibers from the cellulose of grass. We have found a simpler and better method of making synthetic fibers, and corrected the erroneous impression that it is difficult to prepare synthetic fibers from grass cellulose.

Our chemists have also studied Chinese varnish and tung oil, and have found new methods of preparing paints and plastics.

These multiple chemical research projects have helped the development of physical chemistry. Spectrology has been developed in response to the higher demand of precision and speed in metal analysis. It has started the study of the mechanism of evaporation and

agitation. Infrared spectrum analysis was first introduced to China for the analysis of liquid fuel, the study of the structures of a large number of organic compounds, and the study of the structure of high molecules.

The chemistry of complexes has been developed in response to the demand for chemical analyses and fractionations. In the determination of coefficients of complexes between the carboxylic acids and divalent metal ions, we have found that all carboxylic radicals and all metals have a complex reaction with each other.

Therefore, we have re-determined the electrolytic coefficients of several organic acids and their complex coefficients with alkali metal ions and alkali earth ions.

By different methods (spectrophotometry, polarography, and solubility), we have studied the equilibrium theory of complex solutions, and derived the formulae that can be applied under conditions when several complexes co-exist. We are studying the crystal structures of some complexes. We have also done work on salting-out and salting-in in terms of electrostatic and van der Waals forces.

The study of catalysis was developed together with studies of liquid fuel and high molecular polymerization. Chinese chemists have already become familiar with many catalysts and catalytic reactions, and have made some progress in catalytic kinetics.

Petroleum chemists have pointed out, in studying the catalysis of hydrocarbons, that in applying the kinetic formulas of flowing systems, the effect of diffusion should be considered.

They have studied the kinetics of hydrogenation of benzene under high pressure, and obtained some practical results. For the sulfuric acid industry, we have studied the kinetics of oxidation of sulfur dioxide by the catalyst of vanadium.

Colloid chemistry was developed through the study of surface adsorption of the catalysts. In soil studies, we have worked on the ion-exchange of soils, and the rate of gel-formation of silicates during the soil solidification.

The elctrochemists have studied the preparation of rare metals by electrolysis of melting salts. They

use antimony as electric plates to prepare some organic chemicals through electrolysis. They also have achieved success in the improvement of electro-chemical supply and polarographic analysis, and electrodes.

Corrosion-prevention was unheard of in China ten years ago. Already, however, we have done work on aqueous corrosion, atmospheric corrosion, soil corrosion, oceanic corrosion and chemical corrosion. We have established several corrosion stations research centers to study the prevention and retardation of chemical corrosion.

The speedy development of Chinese chemistry in the past ten years has to be attributed to the observance of the science policy of the Chinese Communist Party by Chinese chemists. One of the important policies of the Chinese Communist Party is to ask scientists to learn from the Soviet Union without reservation. The Chinese sc ientists have shown their greatest enthusiasm in learning from Soviet chemists experiences acquired through the reconstruction of socialism, and practical knowledge.

That many Soviet chemists have come to China to give us help is also an important factor contributing to the progress of Chinese chemistry in the past decade. These world-famous chemists, including Nieh-szu-mi-yang-no-fu, academician and dean of the Soviet Academy of Science, have helped the development of Chinese chemistry. They have become most sincere brothers of the Chinese chemists, and have promoted friendship between Chinese and Soviet scientists. The chemists of China and USSR, just like the other scientists of these two countries, will always march forward hand in hand for the prosperity of socialism and the peace of the world.

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